SERVICE MANUAL FOR

FLEXIFLO^{R}-III

ENTERAL NUTRITION PUMP

FROM

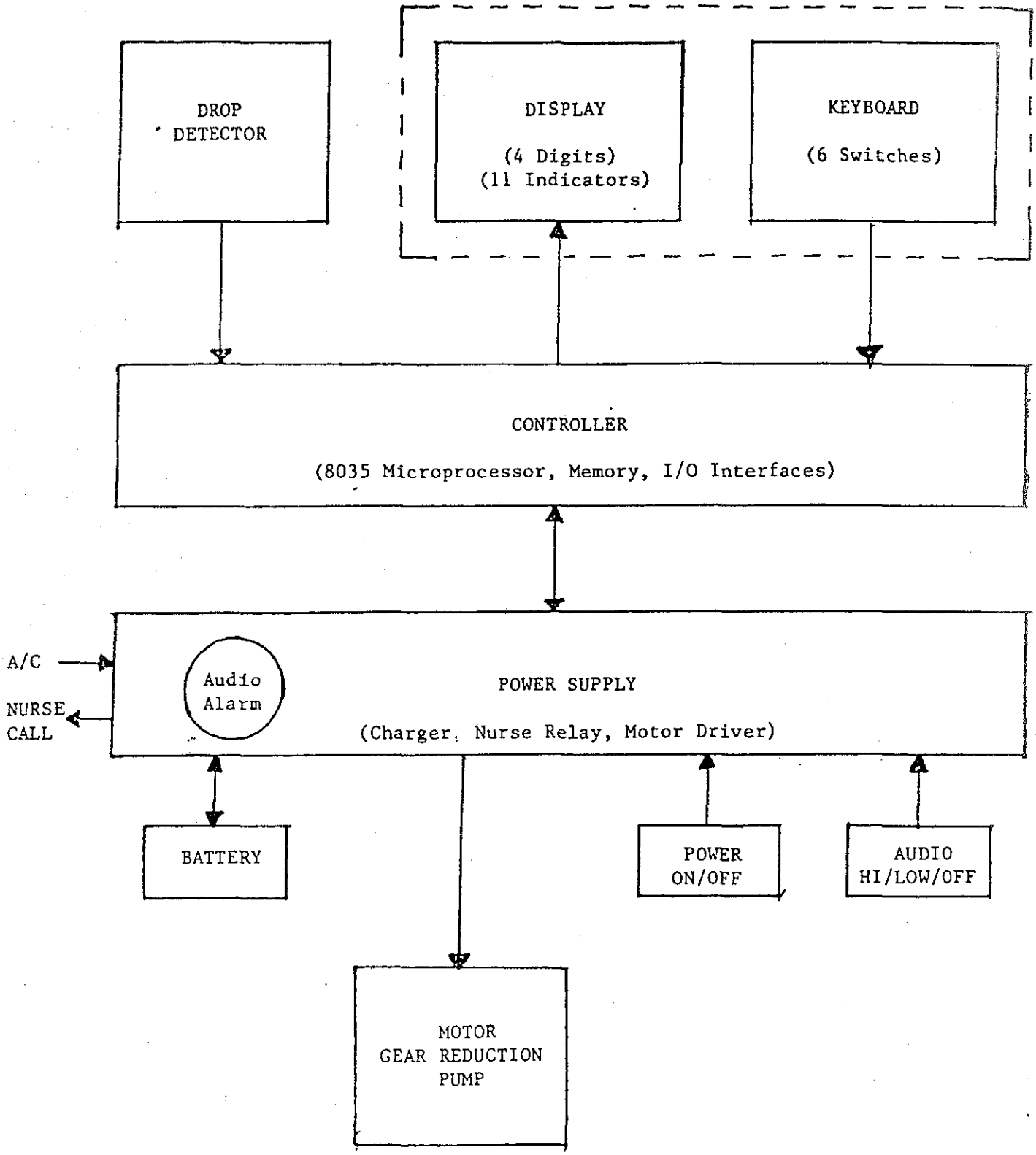
ROSS LABORATORIES

THEORY OF OPERATION

INTRODUCTION

The Flexiflo III Portable Enteral Nutritional Pump provides control and measurement for the administration of enteral feedings at rates of 1 to 300. The pump uses of a rotary peristaltic delivery mechanism in which a pumping chamber is arrayed with 4 rollers in a semi-circular path. Point of contact is provided by the rollers occluding the tubing against a spring loaded backplate. As the rollers move in a clockwise fashion, fluid is propelled out of the chamber. The pump also contains a flow detector to sense no flow conditions, several touchswitches to control pump operation, microprocessor components, a rechargeable sealed lead-acid battery, a power system, and a DC stepper motor.

FUNCTIONAL BLOCK DIAGRAM
FLEXIFLO III



POWER SUPPLY BOARD

Refer to drawing 664002-0200, Power Supply Schematic, for the following discussion:

POWER DRIVE CIRCUIT

The power supply circuit is designed to use input line voltages ranging from 108 to 130 VAC. The AC power enters the circuit via a 1/8 ampere sloblo fuse and goes to the step down, 12 VAC, transformer. The output of the transformer is rectified and filtered by the full wave bridge comprised of 1N4004 diodes and capacitors C1 and C2. The typical output voltage from C2 is approximately 16 VDC, depending on the AC input and the load conditions in the circuit.

The PWRON signal enters the circuit from the controller and display board via pin 14 of connector J1. When PWRON is high, transistor Q2 turns on and draws base current through R2, thereby turning on Q1 via the +V(UN) voltage. A 1K resistor R1 is provided to bias the base-to-emitter junction of Q1 against any drain-source leakage current from Q2, when turned off.

DC SWITCHING REGULATOR

The regulator TIL493C (Z2) normally operates at 20 KHz with the frequency of its internal oscillator set by the 22K resistor R12 and 0.0022 microfarad capacitor C8. The duty cycle of Z2 is controlled by input pins 1, 2, 15, and 16.

The regulator circuit is implemented according to the following approach. The system is operated by current supplied by the AC power supply. A servo loop going through TIL493C (Z2) and transistor Q3 is wrapped around the battery via J4 and routed through a 0.5 ohm resistor R18. This loop maintains a constant current in the battery independent of the load appearing at +V(UN) and the DC voltage coming from the rectifier. When the battery is below its maximum charge level, it is charged at 150 to 220 mA. At 170 mA, R18 produces a potential of approximately

85 mV, which is equal to the internal input offset voltage on pin 15 of Z2. Therefore, during each 20 KHz cycle when the input offset voltage on pin 15 of Z2 is matched by a comparable voltage developed across R18, the internal comparator between pin 15 and 16 turns off. This internal comparator then regulates Z2 in order to maintain the correct percentage "on" time cycle of Q3.

Compensation for this servo-loop is provided by a 15K resistor R11 and 0.1 microfarad capacitor C6. The "on" time of Q3 is controlled by two internal transistors of Z2 which come out on pins 8 and 11. A 390 ohm resistor R14 connects this output to the base of Q3. Because the turn on/off times of Q3 are critical to regulation, the 0.01 microfarad capacitor C9 is provided as a speed-up capacitor. A precision resistor network formed by 1% resistors R9 and R10 is used to set the overage voltage level and cycle time for the system by division of an internal 5 V precision reference output on pin 14 of Z2. The 5 V reference signal is also used to generate the AC/BAT signal to the microprocessor and current is limited by resistor R8.

A 150 microhenry inductor L1 and low ESR (equivalent series resistance), 330 microfarad capacitor C11 are used to provide a constant average DC current of 150 to 220 mA through the battery, independent of all load conditions and input power. When Q3 is shut off by Z2, energy stored in L1 is dumped into C11. An RC network of R15 and C10 coming from Q3 provides critical damping to prevent inductive kickback which would cause the circuit to ring. Schottky diode CR8 isolates the switching regulator from the battery whenever AC power is off. The 5 A fuse F1 is provided in series with the battery to protect printed circuit board in the event +V(UN) is shorted. A low-leakage 8.2 V diode CR9 is connected across the battery to clamp the output circuit at 8.2 V in the event that the unit is operated on AC power with battery removed.

BATTERY CHARGER CIRCUIT

The battery charger circuit is composed of a TIL493C voltage regulator (Z2), an LM3914 display driver (Z4) and a CA3140 (Z3) switchable BI MOS operational amplifer. The battery charger circuit allows use of dual-mode constant-current charging for long battery life. Dual-mode charging is further enhanced by an analog-controlled DC switching regulator (Z2) supplying power to both the fluctuating operational load and battery, thereby maintaining constant charging of the battery independent of operational status of the pump.

The resistor network formed by R16 and R17 provides a feedback voltage to the Z4 from the battery and maintains 3 meg ohms resistance in series to limit the battery drain to 2 to 3 microamperes. The LM3914 (Z4) contains ten comparators designed to divide a narrow voltage range into ten discrete steps. At 5.6 to 5.8 VDC, the comparator at pin 16 will output a high signal to the microprocessor on pin 3 of J1 to indicate a low battery condition. When voltage falls to the range of 5.2 to 5.4 VDC, the comparator at pin 17 outputs a high signal (DSCHRG) to the microprocessor to indicate that the battery is fully discharged. The program then shuts down the pump with a low signal on J1-14.

The LM3914 (Z4) also functions to prevent the battery from overcharging. When battery voltage reaches approximately 7.5 VDC, the comparator at pin 10 outputs a low signal. This signal is tied back to Z4 through the 20K hysteresis resistor R20. This allows the output of pin 10 to return high when battery potential falls below the range of 6.85 to 7.05 VDC. Whenever the output of pin 10 is low, Q4 is turned off which enables the output of Z3. The inputs are connected across R18. Pin 2 is connected through a 470 ohm resistor R23 to the system ground. The 1 meg ohm resistor R25, and 470 ohm resistor R23 form a gain of 2100 for the circuit. Whenever Z3 is enabled by turning Q4 off, Z3 overrides the effect of inputs to TIL493C (Z2) pins 15 and 16 with a large signal applied to the Z2 comparator pins 1 and 2.

BATTERY CHARGER CIRCUIT (continued)

The effect is to control current through R18 at a 1 to 5 mA trickle charge. The hysteresis built into LM3914 (Z4) by R20 holds Q4 off until voltage drops below the range of 6.85 to 6.95 VDC. at which point the CA3140 (Z3) is turned off by Q4, and charging current returns to 150 to 220 mA as controlled by TIL493C (Z2). This circuitry allows the battery to charge in a cycle operating between constant currents of 3 and 170 mA (nominal).

There are two potentiometers associated with LM3914 (Z4). One is a 2K potentiometer (R21) and the other is a 5K (R22). These potentiometers are used to adjust the range of the LM3914 (Z4) comparators and the span in order to make Z4 operate over the appropriate range of 5.28 to 7.50 VDC. The LM3914 (Z4) has an internal 1.25 VDC $\pm$ 5% reference source. The reference signal is biased up from ground by R22 so the net result at point B is equal to 1.25 VDC plus the voltage drop across R22 caused by current from R21. To adjust the Low Batter and Discharged Battery Set points, connect two digitral voltmeters to ground and points "A" and "B" on the Power Supply cord.

Potentiometer R22 should be adjusted until the voltage from ground to point "B" is approximately 2.24 VDC. Next, adjust R21 to approximately 1.63 VDC at point "A". Repeat the adjustments of R22 (point B) and R21 (point A) until the specified voltage is simultaneously present at both points.

There is also a 10K pot R24 on the CA3140 (Z3) which should be adjusted for approximately 0.5 to 2.5 mA at point C when the battery is fully charged. This provides a trickle charge to compensate for self-discharge of the battery. Diodes CR5 and CR6 conduct power to the battery sensing circuit composed of the LM3914 (Z4) in the two cases of use: charging the battery, or discharging the battery during portable operation.

If the unit is turned off, but plugged in to the AC power, the power supply including components Z2, Z3, Z4, and Q3 are active. Because Z4 is also used to detect low voltage and battery discharge trip points, it must be on when the unit is being operated by battery. For this reason, the connection is provided between +V(UN) via CR6.

STEPPER MOTOR DRIVE CIRCUIT

Connector J5 is a 6 pin connector which interfaces the power drive circuit to the stepper motor. The motor operates on two phases at a time in order to obtain desired speed. Four signals, Phase 1 through Phase 4, come directly from the microprocessor on J1 to drive four stepper motor phases using VMOS FETS Q5 through Q8. Four 22 V zener diodes, CR10 through CR13, are employed to absorb kickback from individual motor winding inductances. Four 220K resistors (RP2) are provided to ensure that each associated motor winding control FET transistor stays off completely. Four 10K pull-up resistors are provided to ensure that FET transistors turn on completely.

The Activity Monitor/Nurse Call circuit is composed of CMOS 4098 dual one shot (Z5), CD4011 quad 2 input NAND gate (Z6), relay K1 and other discrete components. The 4098 (Z5) is two one-shots connected in series, each with a different pulse width. The circuit is designed as a pulse-width window detector. If the ACTIVITY signal,generated by the microprocessor on pin 11 of J1 connector, is shorter than the short-time constant or longer than the long-time constant, a ground-level output pulse is provided to the Z6 latch circuit from pin 10 of Z5. The activity circuit is continually refreshed from high-to-low or low-to-high state as generated by proper operation of the program. Thus, if the program fails, an alarm will be generated.

ACTIVITY MONITOR/NURSE CALL

The activity circuit provides a circuit protection function for the system. The ACTIVITY signal is generated in the interrupt routine and reset in the microprocessor's main program. Thus, if the microprocessor or either half of the program fails, the ACTIVITY signal will either not appear or will go to one level and remain. If the ACTIVITY edge no longer functions, the first one shot will cease, failing to trip the second, generating a pulse from pin 10. This pulse will set the latch, generating the malfunction signal NOACT, on pin 16 of J1. Once the delay RC network C19/R34 provides a power on reset to the flip-flop (Z6), any anomaly on the activity circuit will trip the latch and result in a malfunction alarm, which can only be reset by shutting off the unit and restarting it.

If a latch-tripped condition does occur, NOACT will go low and propagate through gate Z6 pins 11-12, tripping the Nurse Call (NCALL) relay. Either the activity circuit or NCALL low from the microprocessor can create the high output on Z6, pin 11. The rising edge propagates through C14, and causes Q9 to turn on briefly and latch the Nurse Call relay.

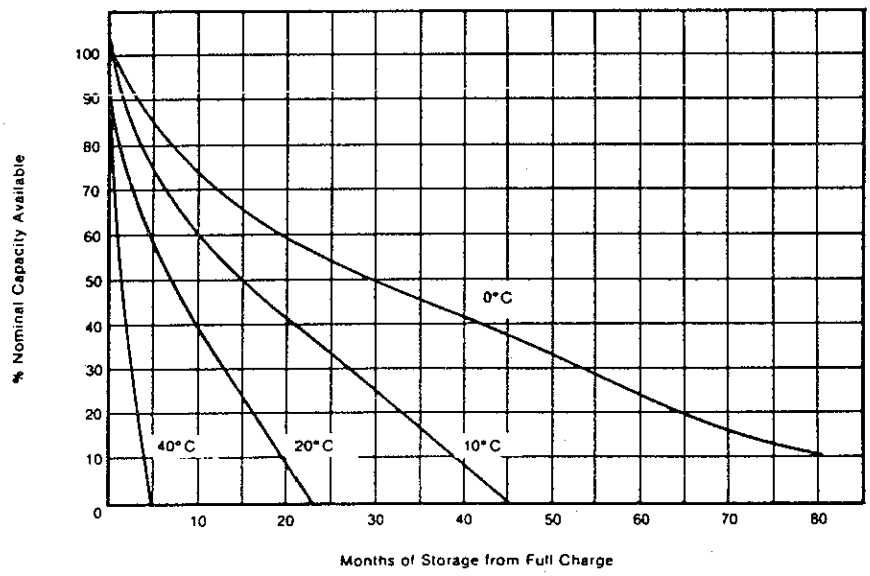
Thus, a low on either one of these inputs will sound the alarm. Under normal conditions when the microprocessor is controlling the system, a low on the alarm input (pin 8 of Z6) will generate an "AA" Morse code pattern from the audible alarm. If NOACT causes an alarm, indicating microprocessor failure, the alarm tone will sound continuously.

The NRESET pulse is input from the microprocessor in order to reset the Nurse Call relay K1. K1 is a latching relay and is turned either on or off by a brief pulse to Q9 or Q10 to set and reset the relay.

BATTERIES

One 6 V, 2.5 ampere-hour lead acid battery is used for powering the pump whenever AC line power is unavailable. The new battery normally provides approximately 8 hours of operation at 300 ml/hr delivery rate.

The battery charger is designed to maintain the battery safely in a fully charged condition; consequently, the pump should be connected to the AC line when not in use to prevent self discharge and to maintain full operating time capacity for emergency or portable operation. If a pump is allowed to remain unconnected to the AC line for long periods of time, the battery may experience a loss of capacity initially, but will recover to full capacity after being cycled a number of times. Typical capacity available as a function of storage time and temperature is shown below.



The controller and display assembly contains four major functional circuits. These are:

1. 80C35 Microprocessor, Memory and I/O
2. LCD and LED Operation Displays
3. Front Panel Touch Switch Subassembly
4. Drop Detector

The microprocessor circuitry is all CMOS technology to minimize power requirements and provide a minimum of 8 hours of battery life.

Refer to drawing 664001-0200, the Controller and Display schematic, for the following discussion:

INITIALIZATION AND SELF TEST

The 80C35 microprocessor (Z1) on the controller and display board is initialized when power is applied to the circuit and capacitor C8 charges to the reset threshold. The microprocessor software then performs an initialization routine which initializes the 80C35 (Z1) and 81C55 (Z4). The program then tests all internal RAM locations in the 80C35 (Z1).

If the internal RAM test fails, the code "E1" is displayed on the four digit LCD display (DS-5) and the program goes into a tight loop to enable observation of the address and data lines using an oscilloscope. If the internal RAM test is successful, the program proceeds with a test of the 256 RAM locations in Z4, the 81C55 RAM/IO chip. If a bad RAM location is found in Z4, the display will show the code "E2" and go into a tight loop for troubleshooting.

A third test is also performed on the 27C32 EPROM. This test, called a ROM CHECKSUM, is generated by first summing all instructions in ROM and then comparing this number to the previously computed and prestored value for this computation. If the two numbers are not identical in value, the LCD will display the code "E3".

INITIALIZATION AND SELF TEST (continued)

If all tests are successful, the program will light all LED's, display "8888" on the LCD display and cause the audio alarm to beep several times. This built-in test sequence will verify operation of all circuitry except the drop detector.

To test the drop detector, a jumper wire may be connected between test points E1 and E2 on the circuit side of the controller and display assembly. The back cover must be removed to gain access to these points. (See Disassembly Instructions).

When test points E1 and E2 are jumpered together, the drop detector will be triggered by the LCD driver clock (approximately 30-150 Hz). This will allow the motor to run continuously without generating a NO FLOW alarm. This feature is useful for testing the Flexiflo III without using a set or fluid to provide drops.

CAUTION

REMOVE JUMPER E1-E2 BEFORE RETURNING FLEXIFLO III TO PATIENT USE, OTHERWISE THE NO-FLOW ALARM WILL BE DISABLED.

MICROPROCESSOR, MEMORY AND I/O

The microprocessor circuitry is a standard 8-bit controller design using a 27C32 EPROM (Z3) and an SN74373N address latch (Z2). The external 256 byte RAM and three 8-bit I/O ports are provided by an 81C55 (Z4) a static RAM with I/O ports and timer. The 81C55 (Z4) reset signal is provided at pin 34, and is generated by the software.

The non-inverting buffer UDN-2595A (Z5) enables the 81C55 (Z4) outports to drive the LED displays. This device can sink 200 mA and thus provides a safety factor of 10 to 1 on the LED drive currents.

MICROPROCESSOR, MEMORY AND I/O (continued)

The microprocessor (Z1) drives the stepping motor on the power supply board using I/O port 2, pins 35-38. These pins produce a wave drive with a phase 1, 2, 3, 4 rotation. Each phase is shifted 90 electrical degrees from the previous wave. The phase drive signals are connected to the VMOS FET driver transistors via J1, pins 5 thru 8.

The Flexiflo III has a watchdog timer (Z5) on the power supply assembly which is held in its inactive state by pulses from Z4, pin 31. This line is toggled high when the program executes the "Main Loop" and is toggled low when the 2 millisecond timer, internal to the 80C35 (Z1), generates an interrupt. This signal (ACTIVITY) is connected to the watchdog circuit (Z5) on the power supply assembly via J1, pin 11. If these activity pulses cease, the watchdog timer circuit will generate a signal called NO ACT which is connected to the microprocessor T1 input (pin 39) via J1-16. When T1 goes low, the microprocessor will halt and the watchdog circuit (Z5) on the power supply assembly will cause the alarm to sound continuously until the power is cycled to the Flexiflo III. If the NO ACT signal reoccurs, a hardware failure has occurred in the Flexiflo III.

The Flexiflo III has a feature in the power supply assembly which detects when the battery voltage falls into the range of 5.2 to 5.4 volts. If detected, the DISCHARGED line, J1-15, goes high and causes the microprocessor (Z1) to make the PWRON signal low and shut down the power supply completely. This prevents total discharge of the battery and insures that the Flexiflo III will be fully functional or fully off, with no unknown states, as the battery discharges.

LED AND LCD DISPLAYS

The LED displays light the alarm messages via the transparent legends on the front panel. These LEDs (LB1-LB7) are light bar assemblies with four diodes connected in a series/parallel arrangement.The green single LED's (DS1-DS4) run at approximately 5 mA and are used to illuminate the indicators in the touch switch legends on the front panel.

TROUBLESHOOTING GUIDE

SYMPTOM OF FAILURE	OBSERVATION	PROBABLE CAUSE	CORRECTIVE ACTION
Fluid delivery stops or will not start	NO FLOW legend is visible	Tubing clamp in closed position	Open clamp.
		Empty container	Refill container.
		Kinked, pinches, or occluded tubing	Straighten tubing or replace set.
		Sight chamber not in drop detector properly	Adjust sight chamber.
		Overfilled drip chamber	Reprime set.
		Fluid bridging on drip chamber cap	Tap drip chamber cap to restore normal drop action.
		Patient's feeding tube is blocked	Flush feeding tube with water to eliminate blockage or change feeding tube.
Flow appears normal	NO FLOW legend is visible	Drops failing too slowly due to viscous fluid	Fluid has thickened with time. Replace with fresh liquid and use a new set.
		Drop detector window is dirty	Clean window.
		Drop detector is defective	Replace drop detector assembly.
No flow alarm does not occur	Conditions to cause a no flow alarm are present	Jumper installed on controller/display E1-E2	Remove jumper.
		Defective controller/display assembly	Repair drop detector circuit or replace controller/display assembly.
Malfunction alarm	Alarm sound continuously	Defective controller/display	Verify activity signal.
		Defective power supply assembly	Check watchdog circuit. Replace defective assembly.
Unit behaves erratically		Defective interconnections	Clean all connectors and check cables for proper insertion.
		Defective controller/display	Replace assembly.
		Defective power supply assembly	Replace assembly.
Nurse Call does not occur upon alarm conditions or does not reset properly		Defective Nurse Call cable	Replace cable.
		Defective power supply assembly	Check R1 or replace assembly.
		Defective controller/display	Replace assembly.

FRONT PANEL TOUCH SWITCH

The front panel is made of several layers of plastic and metal to provide graphics and switch functions in a single subassembly. The connector strip (tail) of the panel plugs into connector J2 on the controller and display assembly. The wiring diagram for the switches is shown in the dotted block labeled TOUCH SWITCH REF on the controller and display schematic. Pin J2-7 connects a shield layer in the panel to the circuit ground to provide static and EMI protection.

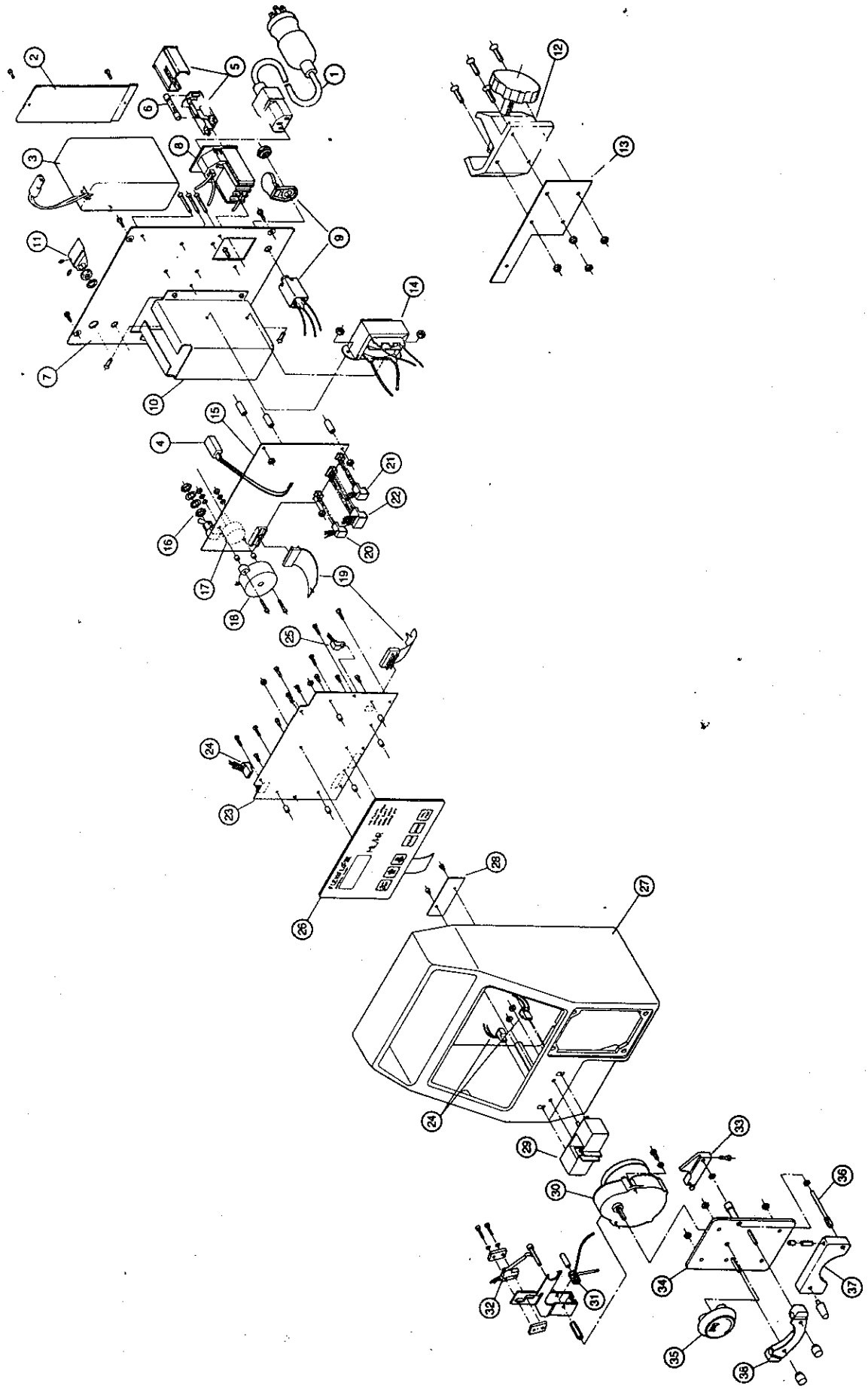
DROP DETECTOR

The drop detector circuit consists of LM393 (AR1) and associated circuitry. The drop detector assembly, which mounts on the left front of the Flexiflo III housing, consists of a plastic enclosure with two TIL39 infrared LED's on the lefthand side and two TIL414 photodetector transistors on the righthand side. The IR LED's are powered from the controller and display card by resistor R1 and FET Q1, which is enabled by the microprocessor program whenever the Flexiflo III is in the RUN mode. Q1 is provided to minimize battery power drain when the drop detector is not in use. When a drop of fluid passes through the drop detector, it causes a shadow to fall on one or both of the phototransistors and causes them to turn off. If either of these transistors (T1L414) turn off, the voltage at test point E1 will rise due to pull-up resistor R3. This voltage pulse is passed by capacitor C4 and causes AR1, pin 2 to go positive. AR1, pin 2 and pin 3 are normally at two diode voltage drops above ground when a drop of fluid is not falling through the drop detector. Therefore, the output of AR1 (pin 1) will go low for a period determined by the time constant of C4, C2 and R21 (approximately one millisecond). Capacitor C2 also provides rejection of high frequency noise.

SYMPTOM OF FAILURE	OBSERVATION	PROBABLE CAUSE	CORRECTIVE ACTION
Unit does not respond to touch switch key	Key is valid in the particular mode of operation. Check operating procedure.	Defective touch switch panel	Replace panel assembly.
		Defective controller/display assembly	Replace assembly.
Low battery alarm does not occur at proper battery discharge level	No LOW BATT legend visible	Power supply assembly out of adjustment	Adjust power supply.
		Defective power supply assembly	Replace and adjust power supply assembly.
No functions at all	Unit will not operate on battery or A.C.	Defective power supply assembly	Replace assembly.
Unit will not operate on battery	A.C. operation unaffected	Discharged battery	Plug into A.C. to recharge. Replace battery if unit will not recharge.
		Blown fuse on power supply assembly	Replace fuse.
		Defective power supply assembly	Replace assembly.
Unit will not operate on A.C.		Blown fuse on rear panel	Replace fuse.
		Defective power input component	Check transfer and wiring.
		Defective power supply assembly	Replace assembly.
Built-in test on power on	"E1" on LCD display	Internal ram defective	Replace 80C35 chip on controller/display assembly
	"E2" on LCD display	81C55 ram defective	Replace 81C55 chip on controller/display assembly
	"E3" don LCD display	EPROM defective	Replace 27C32 EPROM on controller.display.
	"8888" on LCD display is not correct	LCD is defective	Replace LCD.
		LCD is loose in socket	Remove, clean, and replace LCD.
		LCD driver chip is defective	Replace 5453 chip.
	LED's are dim or do not light (NOTE: AUDIO OFF is directly controlled by rear panel switch not the microprocessor and will not illuminate unless AUDIO LO/HI/ OFF is in its OFF position.	Worn out LED or light bar	Replace LED or light bar.
No alarm or feedback tone		Defective audio alarm	Replace audio alarm
		Defective driver	Replace Q11 and Z6.
COVER OPEN legend is illuminated ll the time	Cover is completely closed	Microswitch on lever arm on the rear of the pump assembly is broken	Replace microswitch.
		Broken wiring on microswitch	Repair wiring.

ROSS FLEXIFLO-III PUMP
PARTS LIST
(REFER TO EXPLODED VIEW DRAWING)
REPLACEMENT PARTS AND SUBASSEMBLIES

ITEM	DESCRIPTION	PART NUMBER
1	Power cord	564024-0001
2	Battery access door	564005-0001
3	Battery 6v 2.5 A	140050-0700
4	Battery harness	561004-0001
5	Fuse drawer	121390-0520
6	Fuse 1/8 amp. sloblo	151002-0010
7	Rear panel	664006-0001
8	A.C. power connector/fuse holder	121390-0520
9	Nurse Call cable/power supply assembly	564023-0001
10	Battery housing	664008-0001
11	Audio alarm knob, 1/4" pointer, black	124012-0602
12	Pole clamp assembly	564030-0001
13	Plate, back-up pole clamp	564006-0001
14	Transformer	156000-1694
15	PC assemblies, power supply	564033-0001
16	ON/OFF toggle switch	151100-0259
17	Audio alarm adjust switch, rotary, 2 position	151100-0151
18	Audio alarm	158002-0581
19	16-pin ribbon cable (power supply assembly controller/display)	564022-0001
20	Connector for cable to transformer	121220-0713
21	3-wire cable assembly to Nurse Call jack	564023-0001
22	6-wire cable from motor	564027-0001
23	PC assembly, controller/display	564035-0001
24	4-wire cable (controller/display PWA to drop detector)	121220-0714
25	2-wire cable (controller/display PWA to cover switch assembly)	364013-0001
26	Touch switch panel	564003-0001
27	Closure housing	664003-0001
28	Connector mounting plate	364003-0001
29	Drop detector	664016-0001
30	Motor w/connector	564027-0001
31	Cover spring	364019-0001
32	"Cover open" switch assembly	364013-0001
33	Lever arm	364020-0001
34	Plate, motor mount	564010-0001
35	Pump rotor assembly	564031-0001
36	Lever shaft (rotor cover)	364023-0001
37	Pump rotor cover	664010-0002
38	Tube holder	564029-0002



ROSS FLEXIFLO III PUMP
DISASSEMBLY INSTRUCTIONS
(Refer to Exploded View Drawing)

CAUTION: Disconnect power (item 1) before performing any other disassembly procedures.

NOTE: Unless otherwise noted, reverse disassembly procedures for assembly.

Tools Required

Philips screwdriver - medium
Philips screwdriver - small
Flat blade screwdriver - small
Soldering iron
Needle nose pliers
Allen wrench - 1/6"
Allen wrench - 7/64"

Disassembly Procedures

Item 1. Disconnect Power

a. Turn pump off and disconnect power cord from electrical outlet.

b. Disconnect power cord from back of unit.

Item 2. Removing Battery Access Door

a. Remove 2 Philips screws on battery access door and remove door.

Item 3. Removing Battery

a. Remove battery access door (item 2).

b. Slide battery out through access hole pulling wiring until the battery harness connector is exposed.

c. Snap apart battery harness connector to free battery (item 4).

Item 5. Removing Fuse Drawer

a. Insert screwdriver in slot at top center of fuse holder drawer.

b. Twist screwdriver to release drawer.

c. Slide out drawer.

d. Lift up on center retaining clip and slide fuse holder out of drawer.

Item 6. Removing Fuse

a. Remove fuse drawer (item 5).

b. Pry fuse out of clip.

Item 7. Removing Rear Panel

a. Remove 4 stainless steel Philips screws and separate rear panel assembly from case to expose connectors.

b. Disconnect 16-pin ribbon cable (item 19) from the power supply assembly to controller/display assembly at J1 on the controller/display assembly.

c. Disconnect the 6-wire connector (item 22) from the pump assembly at J5 on the power supply assembly to free rear panel from case.

Item 8. Removing Electrical Connector/Fuse Holder

a. Remove rear panel (item 7).

b. Desolder 3 leads from back of connector.

c. Press in retaining clips on both sides of connector and push through rear panel.

Item 9. Removing Nurse Call Plug

a. Remove rear panel (item 7).

b. Desolder 3 leads from back of plug.

c. Hold spring-loaded cover open while removing retaining nut on back of rear panel.

NOTE: Once nut is loosened, allow cover to close and unscrew nut and cover together.

d. Push plug through rear panel to remove.

e. For assembly, solder wires to leads (refer to schematics).

Item 10. Removing Battery Housing

a. Remove battery (item 3), rear panel (item 7), power supply assembly (item 15), and pole clamp assembly (item 12 and 13).

b. From back of rear panel, remove four, passivated countersunk Philips screws to release battery housing.

c. Remove signal transformer from side of battery housing (item 14).

Item 11. Removing Audio Alarm

a. Remove rear panel (item 7).

b. Desolder wires frm audio alarm at points E1 and E2 (refer to schematic).

c. Remove 2 hex nuts, washers, Philips screws and spacers holding the audio alarm to the power supply assembly.

ROSS FLEXIFLO-III PUMP
Disassembly Instructions (continued)

Item 12. Removing Pole Clamp Assembly

Item 13. Aluminum Back-up Plate

a. Remove rear panel (item 7) and power supply assembly (item 15).

b. Remove 4 countersunk Philips screws and lock nuts holding pole clamp assembly to rear panel and aluminum back-up plate.

Item 14. Removing Power Transformer

a. Remove battery (item 3) and rear panel (item 7).

b. Through access holes, remove 2 countersunk Philips screws and self-locking nuts from side of battery housing.

c. Desolder 4 leads.

d. For assembly, solder wires to leads (refer to schematics).

Item 15. Removing Power Supply PWA

a. Remove rear panel (item 7).

b. On back side of panel, loosen 2 Allen set screws and remove audio alarm knob and insulated retaining nut (item 11).

c. On back side, remove retaining nut and insulating washer from ON/OFF toggle switch (item 16).

d. On inside of panel disconnect connector J2 (item 20) and connector J3 (item 21) from power supply assembly. Separate batter harness connector to battery (item 4).

e. Remove 3 lock nuts.

f. Lift PC board from threaded studs. Leave plastic spacers in place on studs.

Item 23. Removing Controller/Display Switch Assembly

a. Remove rear panel (item 7).

b. Disconnect 4-wire connector (item 24) at J3 and 2-wire connector (item 25) at J6 from PC board.

c. Remove 7 outermost Philips self-threading (thread seeking) screws.

d. Disconnect 16-wire ribbon cable at connector J1 (item 19).

e. Remove 2 lock nuts from center of PC board and separate PC board from touch switch panel (item 26).

Item 29. Removing Drop Detector

a. Remove rear panel (item 7).

b. Disconnect 4-wire connector at J3 from controller/display assembly (item 24).

c. Remove 2 Philips screws and aluminum carrier detector from inside of case.

d. Disconnect 2 connectors (item 24) from inside case.

e. From front of case, remove 2 Philips countersunk screws and release drop detector.

Item 30 thru 38. Disassembling Pump Mechanism

a. Remove rear panel (item 7) and controller/display assembly (item 23).

b. Remove 4 lock nuts on inside of case.

c. Push pump mechanism through front of case.

d. Remove pump rotor cover from front of pump (item 37).

e. Remove 2 acorn nuts to remove tube holder (item 38).

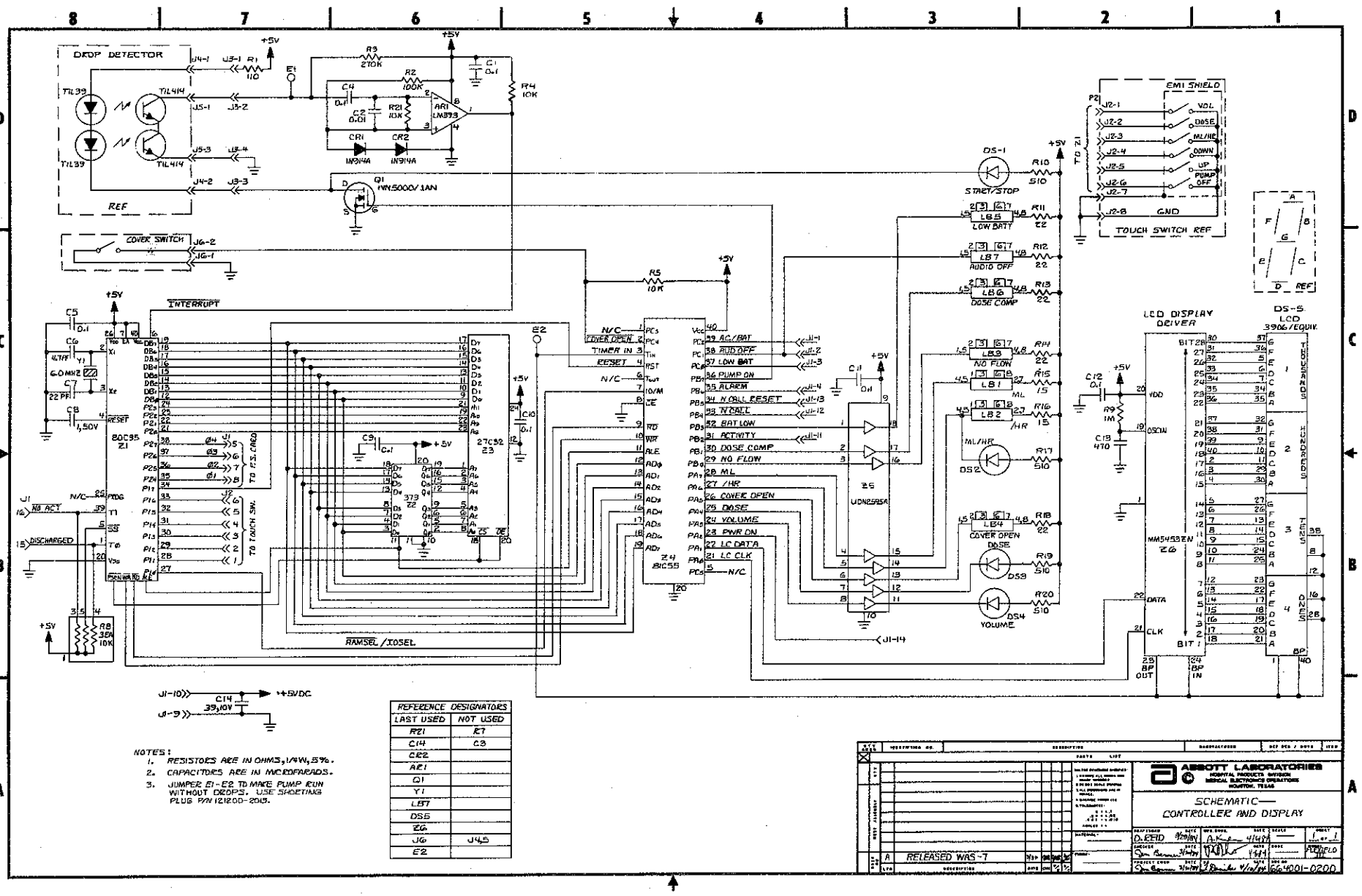
f. Pull pump rotor assembly from shaft where the assembly is spring fit (item 35).

g. Make sure cover open switch is closed so tension is reduced on spring (item 32).

h. Remove Allen screw holding spring in place and remove cover spring (item 31), spacer and 2 washers from stud. Remove stud (item 36)

i. Remove Allen screw holding arm with cover open switch attached. Arm can be removed from shaft and shaft pulled from front of base plate.

j. Remove 2 small Philips screws from cover open switch to separate switch from arm.



REFERENCE DESIGNATORS	
LAST USED	NOT USED
R21	R7
C14	C3
C22	
RZ1	
Q1	
Y1	
LS7	
DS5	
Z6	
J6	J45
E2	

ABBOTT LABORATORIES
HOSPITAL PRODUCTS DIVISION
MEDICAL ELECTRONICS OPERATIONS
HOUSTON, TEXAS

SCHEMATIC—
CONTROLLER AND DISPLAY

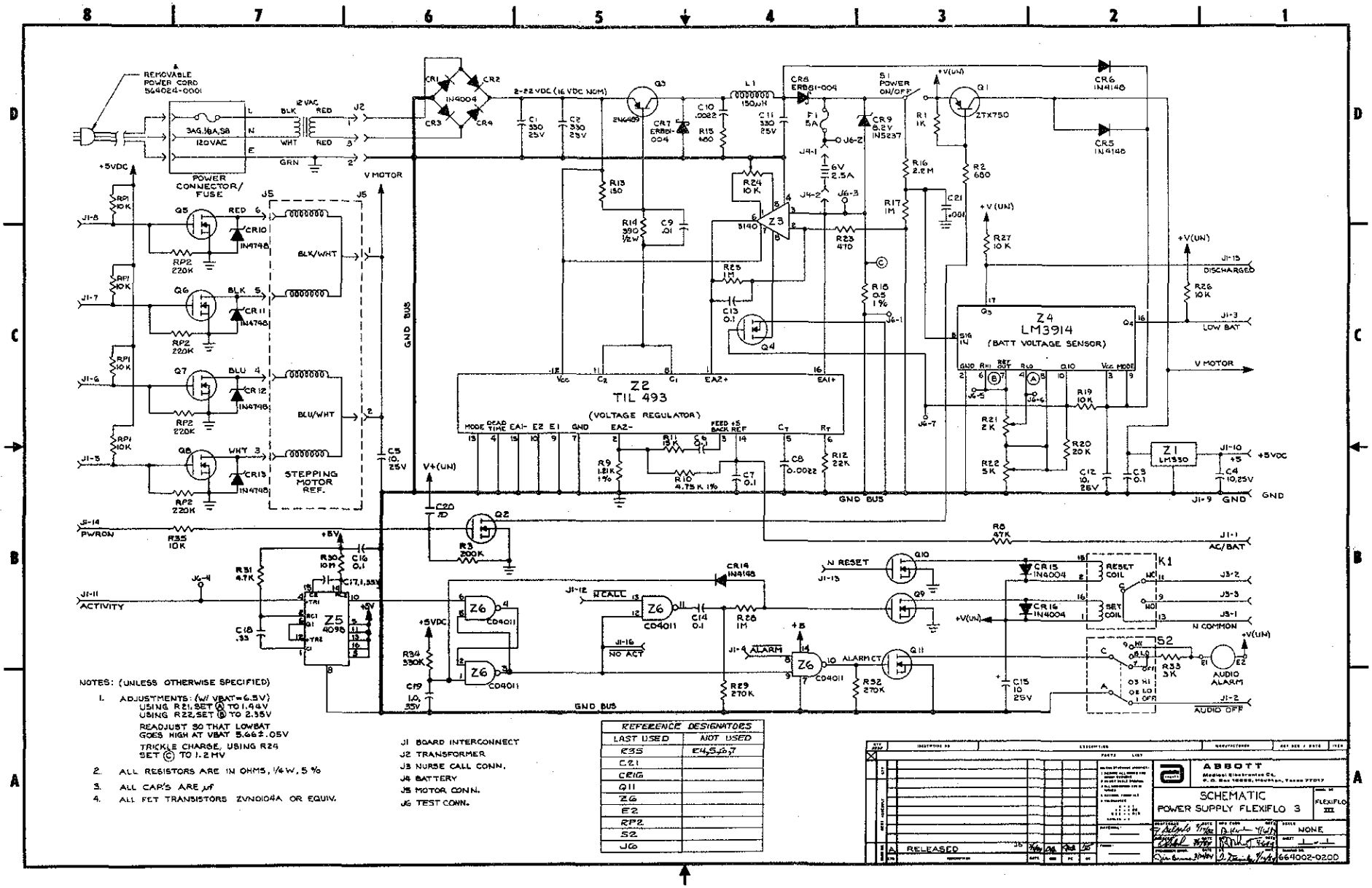
A RELEASED WAS -7

D. REID 9/29/81 — A.K. 4/14/81

P.REID 4/14/81

P.REID 9/29/81 — 4/10/81

6664001-0200



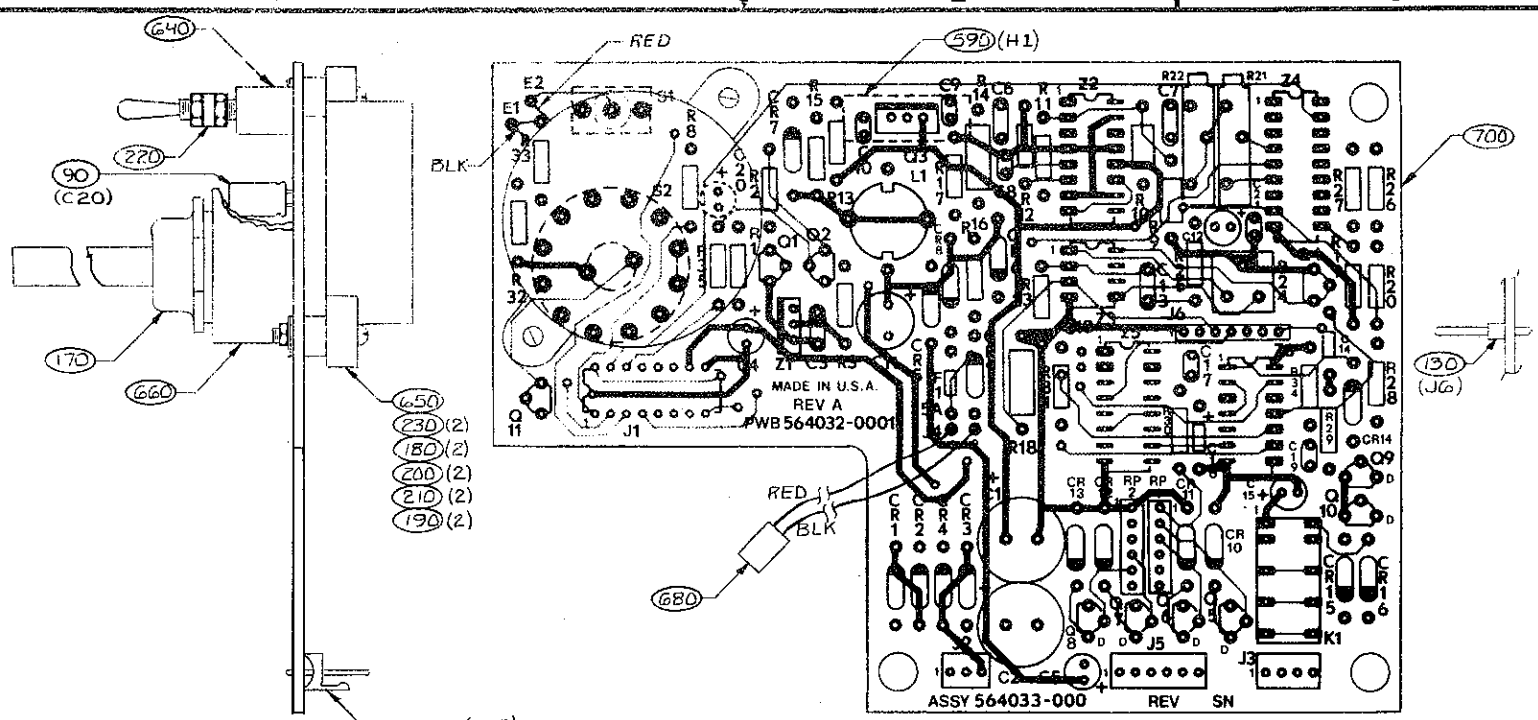
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ADJUSTMENTS: (w/ VBAT=6.5V)
   USING R21, SET Ⓐ TO 1.44V
   USING R22, SET Ⓑ TO 2.55V
   READJUST SO THAT LOWBAT GOES HIGH AT VBAT 5.662.05V
   TRICKLE CHARGE, USING R24 SET Ⓒ TO 1.2HV
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5 %
3. ALL CAP'S ARE µf
4. ALL FET TRANSISTORS ZVN0104A OR EQUIV.

J1 BOARD INTERCONNECT
J2 TRANSFORMER
J3 NURSE CALL CONN.
J4 BATTERY
J5 MOTOR CONN.
J6 TEST CONN.

REFERENCE DESIGNATORS	
LAST USED	NOT USED
R35	E4,5,6,7
C21	
CR16	
Q11	
Z6	
E2	
RP2	
S2	
J6	

ABBOTT
SCHEMATIC
POWER SUPPLY FLEXIFLO 3
FLEXIFLO III
NONE
A RELEASED
664002-0200



QTY REQD	IDENTIFYING NO	DESCRIPTION	MANUFACTURER	REF DES / NOTE	ITEM

PARTS LIST

LTR	DESCRIPTION	DATE	CHK
C	INC ECO 51867, DISP. D	4/1/84	JD
B	INC ECO 51818, DISP. D	3/14/84	JD
A	RELEASED	3/14/84	

UNLESS OTHERWISE SPECIFIED
1. REMOVE ALL BURRS AND SHARP CORNERS
2. DO NOT SCALE DRAWING
3. ALL DIMENSIONS ARE IN INCHES
4. MACHINE FINISH 125
5. TOLERANCES
.X ± .1
.XX ± .02
.XXX ± .010
ANGLES ±

MATERIAL

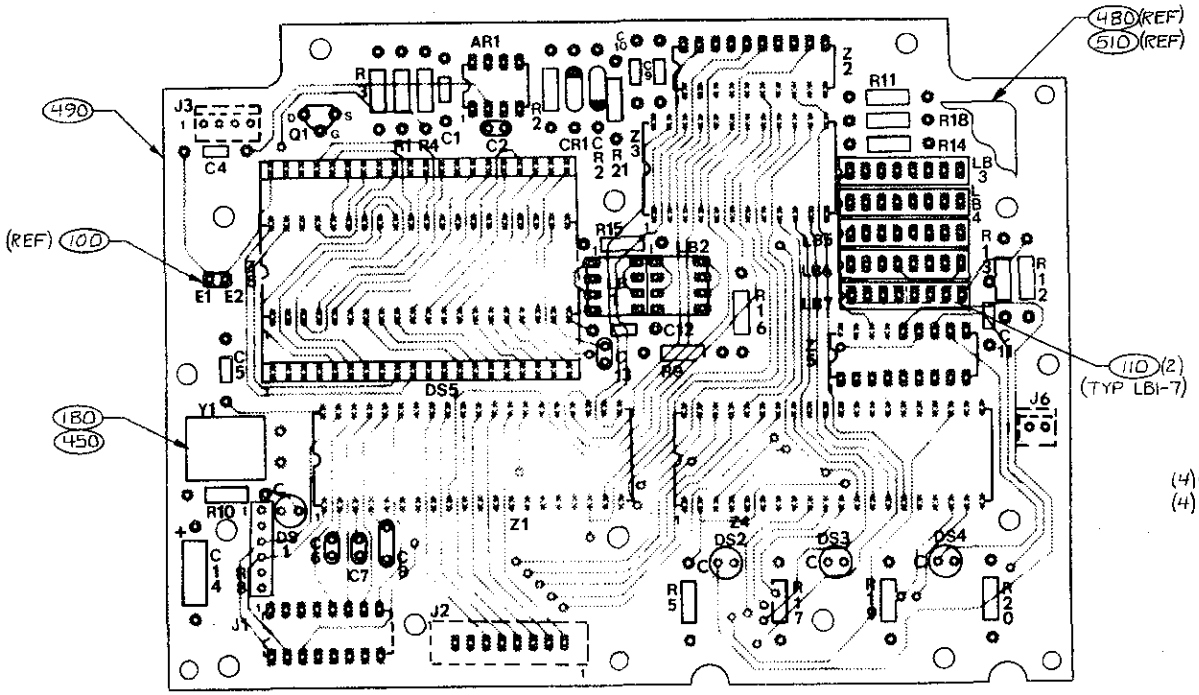
FINISH

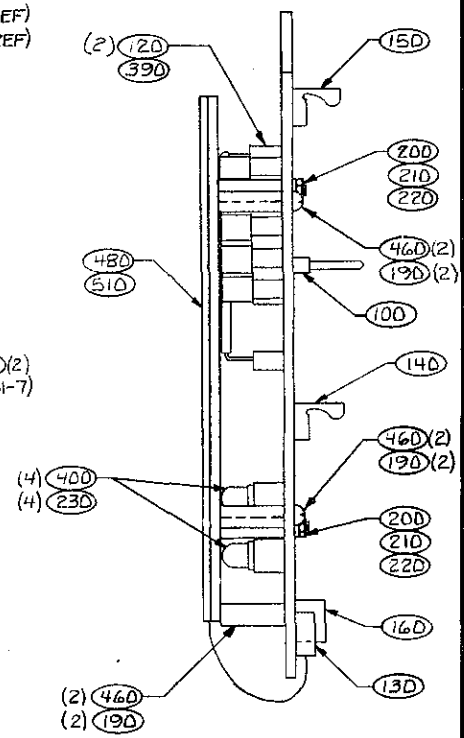
ABBOTT LABORATORIES
HOSPITAL PRODUCTS DIVISION
MEDICAL ELECTRONICS OPERATIONS
HOUSTON, TEXAS

P.C. ASSEMBLY —
POWER SUPPLY

		DATE
DRAFTSMAN	D. Reid	3/20/84
MFG ENGR	A. K...	4/13/84
CHECKED	[illegible]	4/13/84
	[illegible]	4-13-84
PROJECT ENGR	[illegible]	4/13/84
	[illegible]	4/13/84

SCALE —
SHEET 1 OF 1
CODE —
MATERIAL FLEXIFLEX
DWG NO 564033-0001





QTY REQD	IDENTIFYING NO	DESCRIPTION	MANUFACTURER	REF DES / NOTE	ITEM
		PARTS LIST			

QTY	NEXT ASSEMBLY	DASH NO	LTR	DESCRIPTION	DATE	CHK
		B		INC PER 51818, DISP D	3/16/94	
		A		RELEASED	3/16/94	

UNLESS OTHERWISE SPECIFIED
1 REMOVE ALL BURRS AND SHARP CORNERS
2 DO NOT SCALE DRAWING
3 ALL DIMENSIONS ARE IN INCHES
4 MACHINE FINISH 125
5 TOLERANCES
.X ± .1
.XX ± .05
.XXX ± .010
ANGLES ± 1°

MATERIAL
FINISH

ABBOTT LABORATORIES
HOSPITAL PRODUCTS DIVISION
MEDICAL ELECTRONICS OPERATIONS
HOUSTON, TEXAS

P.C. ASSEMBLY
CPU / DISPLAY

	NAME	DATE
DRAFTSMAN	D. Reid	3/21/94
CHECKER		3/16/94
PROJECT ENGR.		4-6-94
MFG. ENGR.	A. Kuo	4/11/94
		4-6-94

SCALE
SIZE
PETEXFLE
DWG NO. 56035-001
SHEET 1 OF 1